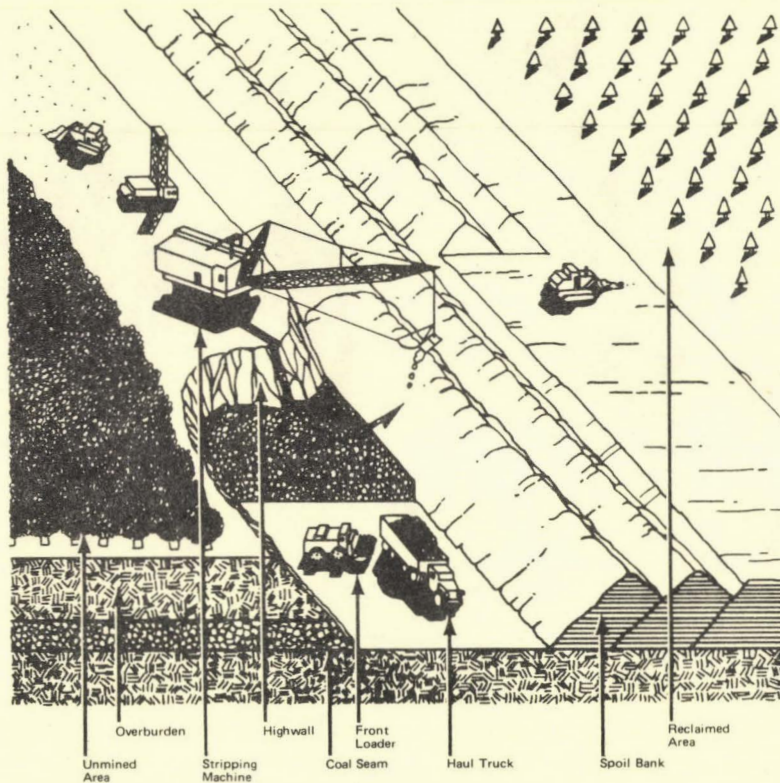


3

# SURFACE REHABILITATION OVERVIEW

guide to rehabilitating  
surface-mined land in the west



Area Mining

Pittsburgh & Midway Coal

## GROWTH OF SURFACE MINING

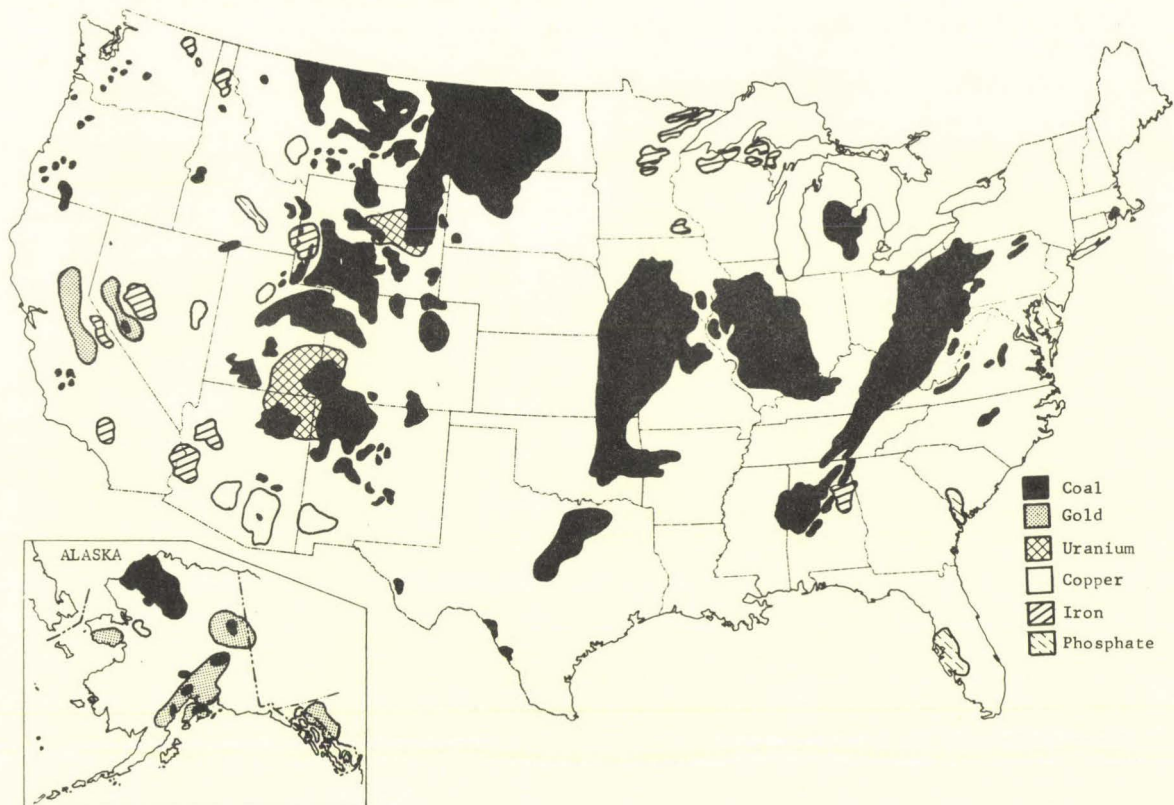
Surface mining removes underground minerals by "going in from the top"—simply removing the overburden of soil and rock, and taking the desired substance away. It is faster and more efficient than underground mining, making it economically attractive. "Area mining" is the most common method in the West—see figure on cover.

Surface mining has been around for a long time, from copper mining by Southwestern American Indians centuries ago, to present-day removal of over 50 different substances throughout the United States. Some of the materials surface-mined are

coal, sand, gravel, uranium, oil shale, gold, clay, phosphate, copper, iron, and molybdenum (Figure 1).

The most heavily surface-mined commodity by far is coal. Growth in surface-mining of coal, both in tonnage and in proportion to underground mining, has accelerated dramatically in the past 10 years (Figure 2). Half of the nation's 600 million tons mined annually are removed from the surface.

Experts project that more coal will be mined each year, and more of it will be surface-mined. Fortunately, the United States is endowed with plentiful supplies of coal of various types (Figure 3).



U. S. Fish and Wildlife Service

Figure 1. Major Mineral Surface-Mining Areas of the United States



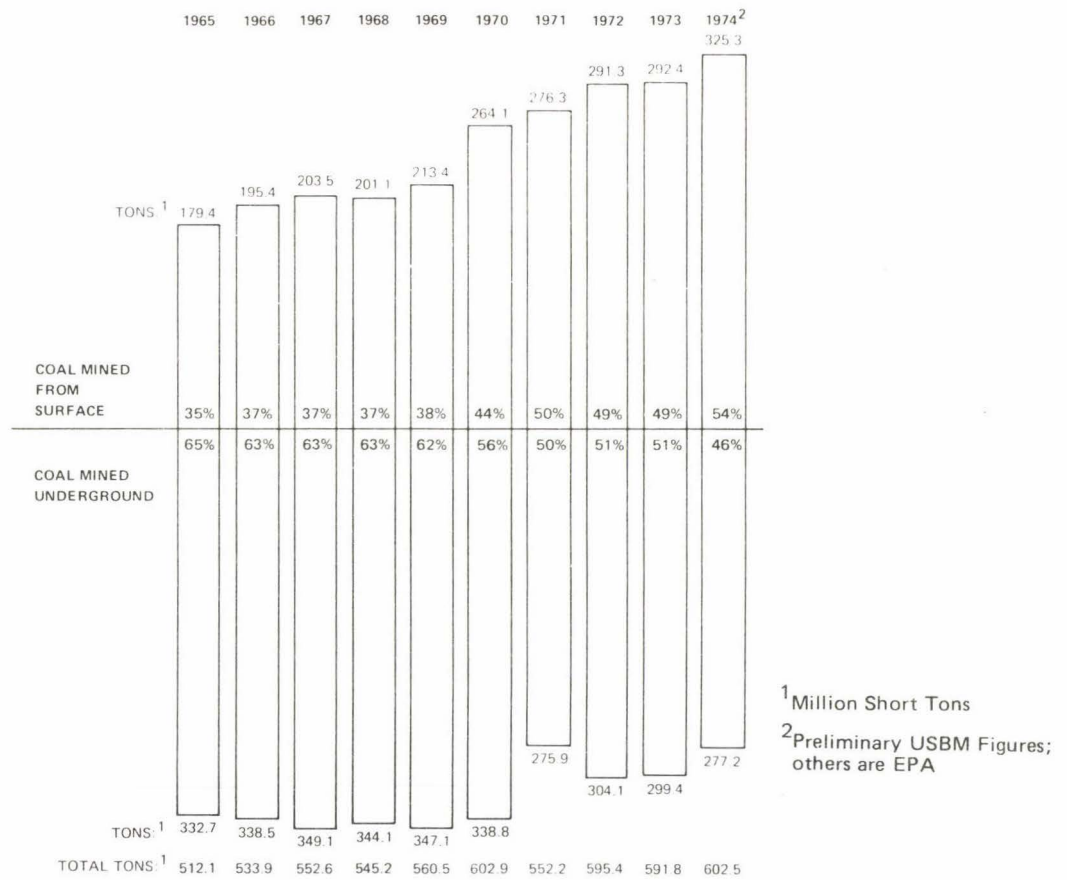
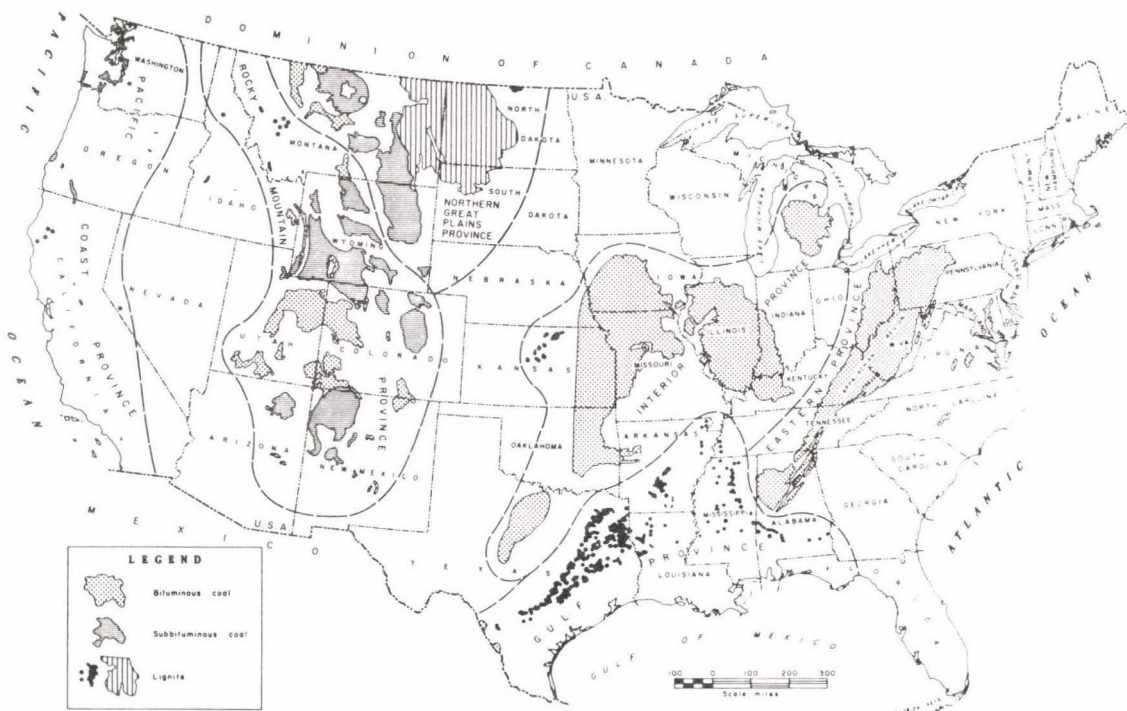


Figure 2. Surface-Mined vs. Underground-Mined U. S. Bituminous and Lignite Coals



Ballinger Publishing Co. (Reference 1)

Figure 3. Coal Fields of the United States

## SURFACE MINING IN THE WEST

Western coal is attractive not only for its low sulfur content (generally under 1%, making it desirable as a low-pollution fuel in generating electricity), but due to the generous surface-minable reserves (Figure 4). Figure 5 shows the intensity of the "coal rush" in the West. During the remaining 25 years of this century, the coal to be surface-mined will be over 12 times that removed

in the past 50 years. The acreage disturbed in the process will be about 9 times that disturbed in all the years up to the present. States having very thick coal seams (such as Wyoming, where seams average 30 feet thick and sometimes exceed 100 feet) can produce more coal per acre, and thus will experience less surface disturbance per ton than states having thinner coal seams (such as the Four Corners states, Washington, and the Dakotas, where seams average 10–15 feet).

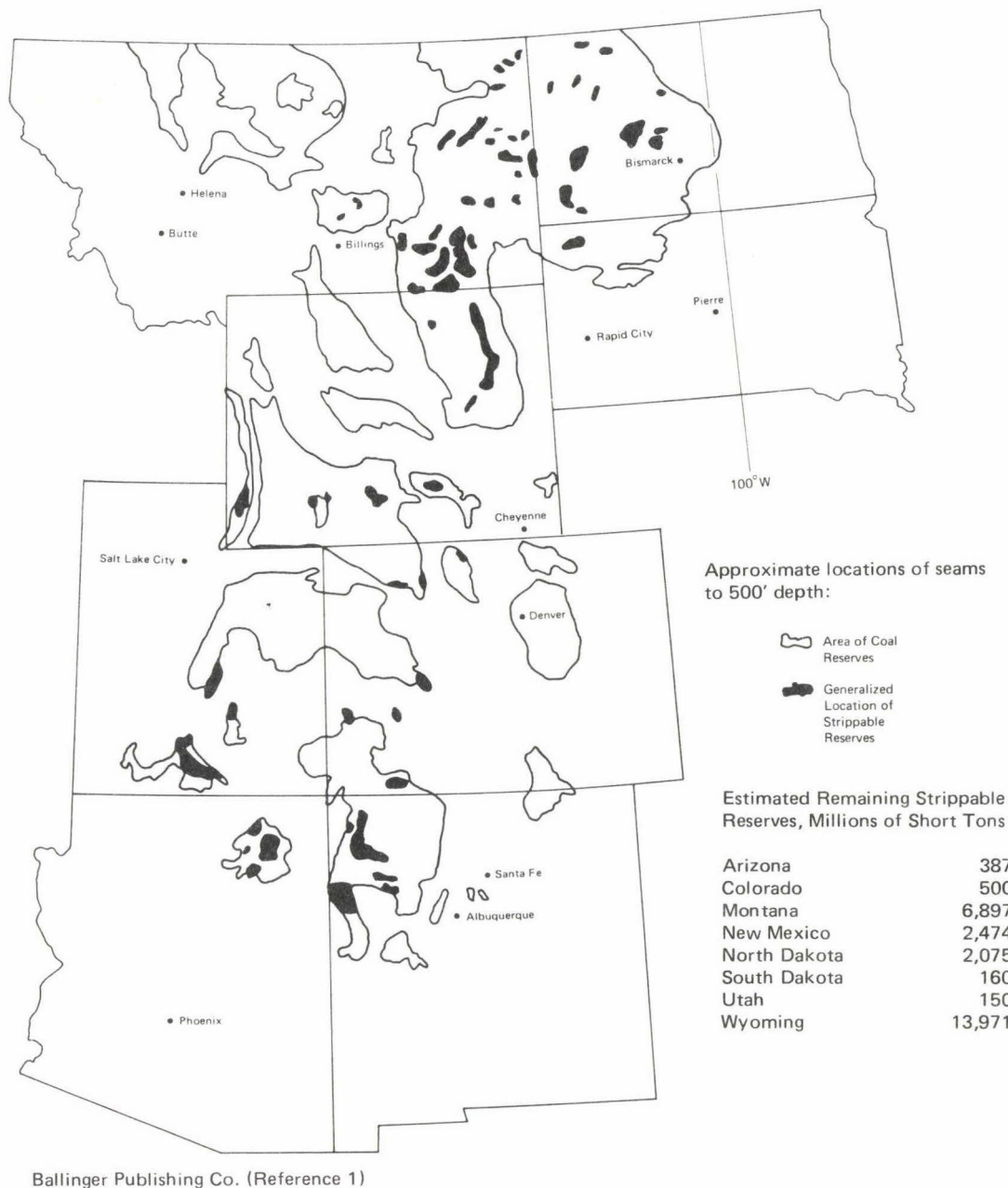


Figure 4. Surface-Minable Coal Reserves in the Western States



State	Surface Coal Mined		Land Disturbed By Surface Mining	
	1920's - 1972 (Millions of Tons)	Projected 1972 - 2000 (Millions of Tons)	1920's - 1972 (Acres)	Projected 1972 - 2000 (Acres)
Arizona	1.3	497.9	100	38,836
Colorado	21.3	112	3,000	8,736
Montana	56	917	2,100	42,182
New Mexico	32	529.5	2,900	32,829
North Dakota	104.1	347.3	9,700	22,227
South Dakota	1	20	900	1,280
Utah	(Slight)	115	(Slight)	8,280
Washington	2.7	131.5	200	10,520
Wyoming	69.9	983	1,800	23,592
<b>TOTAL</b>	288.3 Million Tons	3,653.2 Million Tons	20,700 Acres	188,482 Acres

National Academy of Sciences

Figure 5. Coal Mining and Land Disturbance in the West

## SURFACE MINING PROBLEMS

The nation profits from surface mining.  
But with the profits come the problems:

### Land Surface:

After minerals are mined, the shape of the land is usually altered. Spoil piles of overburden are left which may not support vegetation. Topsoil may be lost. Haul and access roads cross the landscape. Steep slopes increase the opportunity for erosion and landslides.

### Water:

Watersheds may be altered. Streams may be widened, narrowed, filled with sediment, chemically polluted, or have their courses changed. The effects of mining may be felt many miles downstream. Lakes may be drained; new lakes and ponds may be created. Altered drainage may create flooding problems during heavy storms. Earth strata that are good water sources ("aquifers") may dry up.

### Fish and Wildlife:

Removal of vegetation deprives wildlife of nesting, cover, and forage. Altered land surfaces may affect migration, and limit animal mobility. Changes in streams and lakes may disrupt fish spawning grounds and waterfowl habitats.

### Plants:

Plants in nature live in careful balance with one another; mining removes plants, changing this balance. Mine spoils often will not support plant growth.

### Recreation:

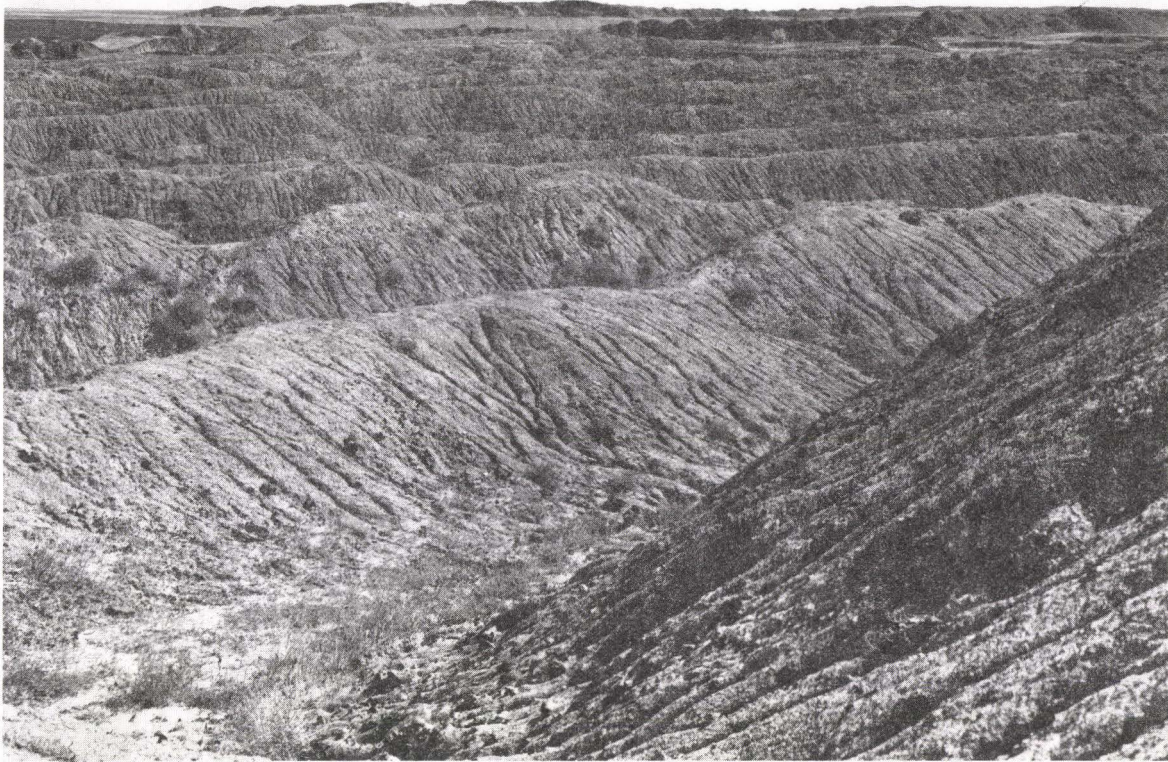
Hunting and fishing grounds may be disturbed. Lakes may become unsuitable for recreation because of sediment or change in depth and drainage.

### Access to Land:

Mining often renders an area inaccessible, by creating rough terrain and altering streams.

### Esthetics:

Mine sites are generally unsightly.



USDA Soil Conservation Service

Figure 6. Abandoned Spoil Banks Near Firesteel, South Dakota

#### **Land Value and Taxes:**

Mined land that is unrehabilitated (like that in Figure 6) is nearly worthless. Depending on local policy and the assessment on coal-company-owned land, mined land generates either greater or lesser revenue than unmined land, thus influencing the tax burden on other land owners.

#### **Safety:**

Mined areas may be attractive to youngsters, increasing the safety problems caused by abandoned buildings and equipment, unstable spoil piles, ponds, and general debris.

#### **BLESSINGS IN DISGUISE**

Despite the problems, surface mining offers a great opportunity to make land even more useful than it was before mining. Here are some possible uses for mined land:

#### **Agriculture**

Orchards	Timber
Vineyards	Farmsite
Croplands	Range
Pasture	Livestock
Christmas Trees	

#### **Recreation—Land and Water**

Swimming	Park
Fishing	Campground
Boating	Auto/Bike Racing
Hunting	Hiking
Golf Course	Athletic Field
Target Range	Playground
Amusement Park	

#### **Conservation and Esthetics**

Game Preserve	Bird Sanctuary
Woodland	Scenic Area



## Urban Development

Residential	Airfield
Commercial	Refuse Disposal
Educational	Reservoir
Parking Lot	Sanitary Landfill
Institutional	Cemetery
Industrial	
Sewage Treatment	

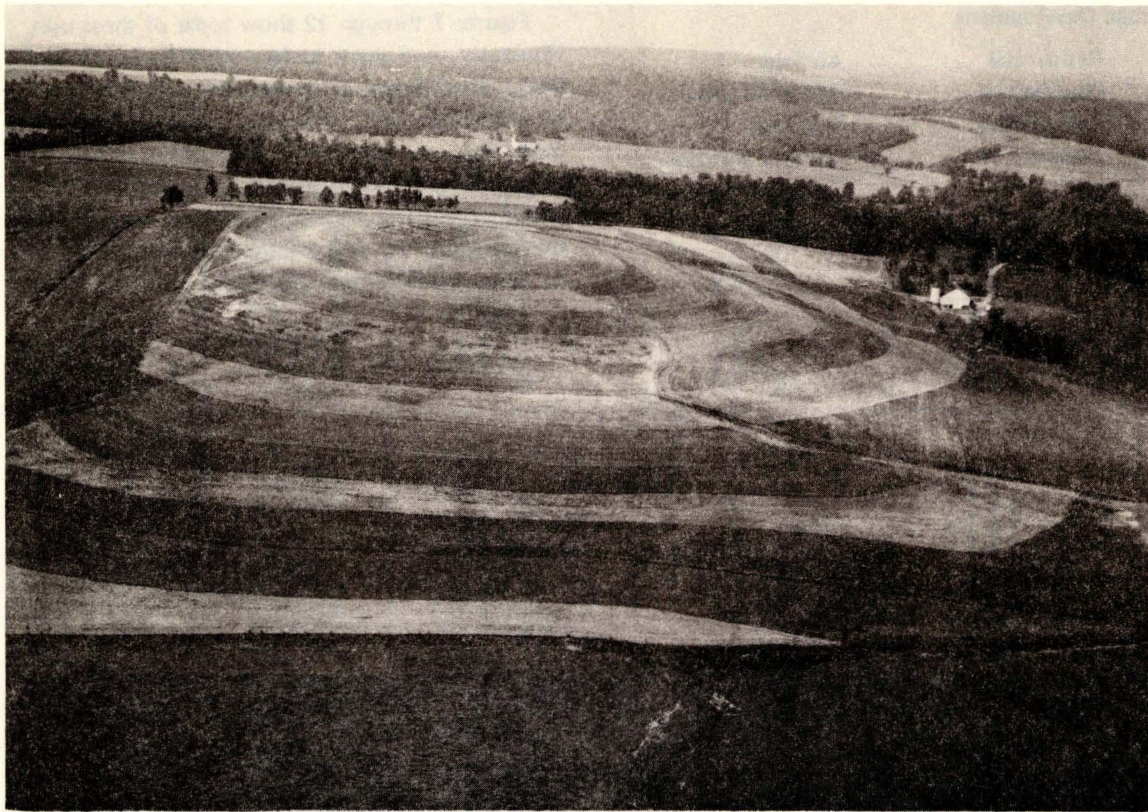
Figures 7 through 12 show some of these uses. Obviously, not every surface mine lends itself to being rehabilitated as an orchard, swimming area, or industrial park. On some western sites, the most one can hope for is to establish a healthy growth of well-rooted vegetation to hold the spoil and provide livestock forage. But no matter what the problems are at a specific site, something can be done to rehabilitate the land.



W. M. Spaulding, Jr., U. S. Fish and Wildlife Service

Figure 7. This Surface Mine Has High Potential As a Water Recreation Area





Pennsylvania State University

Figure 8. Farm Land on a Former Surface Mine



Coal Age

Figure 9. Poplar and Yellow Clover Densely Cover Former North Dakota Surface Mine





National Coal Association

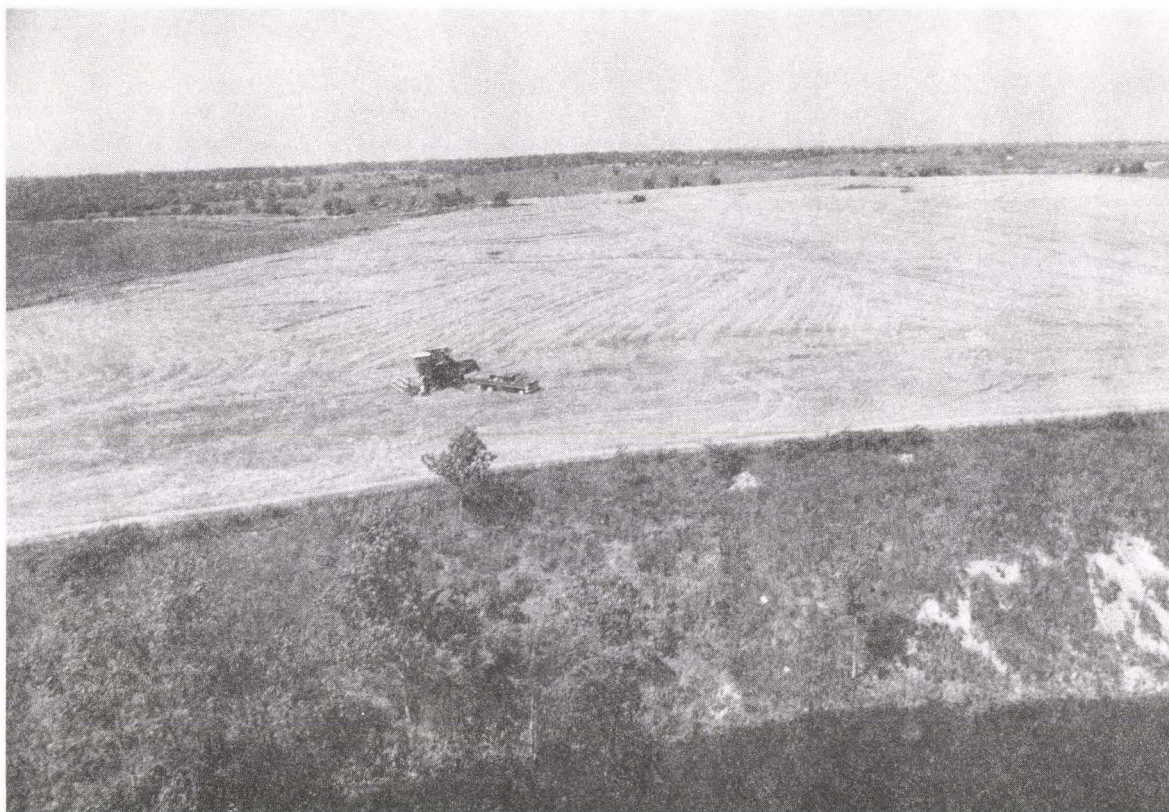
Figure 10. Charolais Cattle Grazing on a Former Surface Mine



National Coal Association

Figure 11. Oat Field on a Former Surface Mine





National Coal Association

Figure 12. Wheat Field on a Former Surface Mine

## REHABILITATION IN THE WEST

"There has been too much identification of [the West's] coal industry with the problems of Appalachia . . . . The problems of Appalachia just simply are not the problems of [the West]. Conditions are different, coal is different, the overburden is different, ground water conditions are different, the topography is different, land values are different, population density is less, and comparison is . . . unrealistic."<sup>1</sup>

The Western coal lands pose their own special set of rehabilitation problems. These are the important characteristics of Western coal lands that influence rehabilitation:

<sup>1</sup>Thomas A. Gwynn, *Director of Public Relations and Environmental Affairs for the Knife River Coal Mining Company, Bismarck, N. D.*

### Water:

Water is scarce in much of the arid and semi-arid Western coal area. 75% of the area receives 20" or less of precipitation a year. 20% of the area receives 10" or less. Estimates are that over half of this water evaporates, and thus is not available to plants. Most precipitation arrives seasonally, sometimes as high-intensity storms, but it is very erratic and unpredictable. Floods from storms may cause severe erosion. Droughts are common; in many arid areas, natural revegetation can occur only when there are two or more successive years of ample moisture. Water scarcity is the largest single problem in revegetating Western surface mines.

### Temperature:

The annual temperature ranges from  $-60^{\circ}$  to  $+120^{\circ}\text{F}$ ; extreme daily fluctuations are common. In the north, a short frost-free growing season prevails. The early-afternoon



sun may heat the soil enough to kill seeds and seedlings of all but the best-adapted plants.

#### **Wind:**

Wind erosion may make revegetation difficult on exposed slopes. High winds may damage seedlings by blowing them over or "sandblasting" them with high-speed particles. Winds hasten evaporation, removing water from the soil.

#### **Soil:**

Many western soils are poorly developed and make poor seed beds. They are often alkaline (basic), saline (salty), or sodic (high in sodium). They are often rocky or high in clay, both of which make plant establishment difficult. Nitrogen (N) and phosphorus (P) are often deficient. Since vegetation is sparse, there are few plants to decay and form humus, and the surface is poorly protected from wind and water erosion.

#### **Topography:**

Steep, barren, rocky slopes do not retain water, and may be subject to erosion.

#### **Plants:**

Plant communities in arid regions are fragile—once disturbed, they require decades to recover. Some western surface-mined lands have such harsh environments that natural revegetation, unassisted by man, could take centuries. Many native plant seeds are tiny and planted shallowly, making them easy victims of extreme temperature, wind, and flash floods. Only the hardy survive. Uncontrolled grazing by domestic animals and wildlife may wipe out a planting that has just gotten a foothold.

#### **Land Ownership and Regulation:**

Surface rights, mineral rights, and water rights may be separately owned for a single piece of land. Owners range from Federal and State governments, to Indian nations, to railroads, to private individuals. Different regulations may apply to each owner and each right, depending on what government body has control.

#### **Acid Mine Drainage:**

While high-sulfur coals in the East cause serious problems in Appalachia, acid drainage rarely occurs in the West, due to the low sulfur content of most western coals.

#### **WHO MUST REHABILITATE MINED LAND?**

There are two kinds of surface-mined lands:

- Lands mined before any rehabilitation or reclamation laws existed. Some of these lands have been graded and returned to productive use; the rest of them are "orphaned" lands.
- Lands mined under the control of law.

The first type, orphaned lands, are generally regarded as a public problem, something that the government must take care of. Some of these lands are gradually being rehabilitated with Federal and/or State funds.

The second type, lands mined after passage of a law or establishment of a regulation, is usually the responsibility of the mine operator to rehabilitate. Operators must adhere to the specific requirements in each state.

#### **REHABILITATION COST**

If there is any rule-of-thumb on estimating cost, it is: *Rehabilitation cost is unique to the site.* One reliable estimate of cost is \$700–\$1800 per acre.<sup>2</sup> Another shows a range of \$925–\$2,750 per acre (Figure 13).

Cost per acre for rehabilitation depends on:

- Water availability for plant growth
- Amount of grading and contouring necessary
- Soil fertility
- Local climate
- State requirements
- Water, drainage, and erosion control necessary
- Final end-use of land desired
- Many other factors, from local wages to equipment availability

So, it is impossible to cite a simple dollar amount per acre. Rehabilitation cost depends entirely on the site and the end-goal of rehabilitation.

<sup>2</sup>Reference 8, page 38.

<i>Treatment</i>	<i>Cost per acre</i>
Land shaping	\$200 — 400
Micro surface manipulation	50 — 150
Water control on slopes	50 — 100
Channel drainage	50 — 200
Sediment control in detention basins	100 — 200
Subtotal	\$450 — 1050
Seed	30 — 70
Fertilizer	25 — 60
Soil amendments	25 — 70
Mulching	100 — 300
Shrub or tree planting	50 — 200
Subtotal	\$225 — 700
Topsoil replacement (less than 6 inches)	250 — 500
<b>TOTAL</b>	<b>\$925 — 2750</b>

In addition there may be rehabilitation of roads at costs ranging from \$500 to \$2,000 per mile.

National Academy of Sciences

Figure 13. Estimated Direct On-Site Costs for Rehabilitation in Western Coal Fields

### HOW LONG DOES IT TAKE?

Like cost, the time required for rehabilitation depends entirely on the problems at each site. If one has a reasonably good plant-growth medium, gentle slopes, and 30" of rainfall a year, a stand of grass can be established in a summer. In arid areas with difficult soils, it may require 3–5 years for a grass seeding to become established.<sup>3</sup>

### WHERE WE STAND

Figure 14 shows how much U. S. land has been surface-mined, and how much has been rehabilitated. Two-thirds of surface-mined coal lands have been rehabilitated, due in part to the relatively short life of a surface coal mine—it may be mined and rehabilitated in just a few years. Mining for other substances often continues for many years at the same site, delaying rehabilitation.

### RESEARCH IN PROGRESS

Rehabilitation in the West is fairly new, and while surface-mined areas are being successfully

rehabilitated, we have much to learn. Problems currently under study include:

#### Irrigation:

How practical is irrigation on surface-mined land? How expensive?

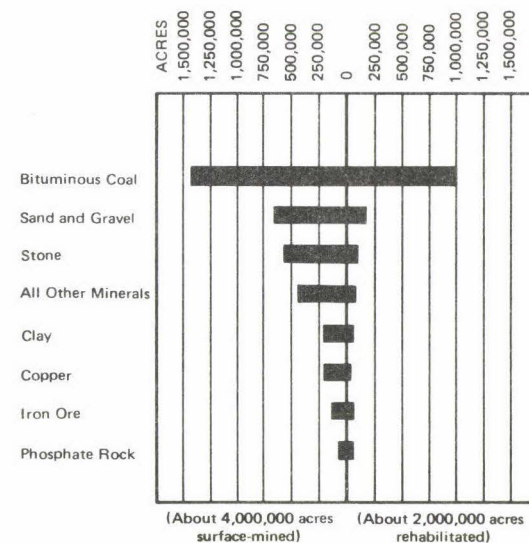


Figure 14. U. S. Acres Surface-Mined and Rehabilitated, 1930–1971

<sup>3</sup>“Established” means at least four thriving plants per square foot, as defined in reference 10, page 22.

**Retaining Rainwater:**

How can we retain the scant rainwater that falls? How can spoils be shaped to hold water better?

**Plant Materials:**

What grasses, forbs, and trees can best thrive on the harsh environment of a mine spoil pile?

**Spoil Treatment:**

How can we best shape and amend spoils for revegetation?

**Predicting Rehabilitation Costs:**

How can we precisely predict the cost of rehabilitating a given surface-mined area?

**Predicting Rehabilitation Success:**

How can we reliably predict the success of a given rehabilitation job?

**Fertilizing:**

What nutrients, and how much of each, are most effective in promoting growth on spoils?

**Steep Slope Revegetation:**

What equipment and methods can we devise to reliably and quickly revegetate steep slopes?

**Mining Methods:**

What mining techniques will make rehabilitation faster and simpler, and make it possible to extract deep coal (below 200')?

**Water-Bearing Earth Layers (Aquifers):**

Mining may disrupt these. How can they be put back?

**Social Factors:**

What long-term effects does surface mining have on the people living in the area?

**Equipment:**

What equipment can be developed to speed rehabilitation, and reduce its cost?

**Groundwater:**

What effect does surface mining have on groundwater chemistry?

**FINANCIAL AND TECHNICAL HELP**

Financial and technical assistance in rehabilitation is available from Federal, State, Local, and private sources. Lead times for getting assistance are usually long; the best bet is to start at the *local* level.

Local agencies usually know about specific problems in the area, available financial aid, and organizations carrying out rehabilitation in the area. Reliable agencies to contact are:

- Soil Conservation District (under the county name in the phone book). Most Conservation Districts offer engineering, planning, and agricultural help; equipment for surveying, fertilizing, and planting; trees and tree-planting crews; and cost-sharing for planting.
- County Agricultural Extension Office (under the county name in the phone book). Services include soil information, help in selecting plants and planting methods for rehabilitation, fertilizer recommendations, etc.
- U. S. Soil Conservation Service (under U. S. Government in the phone book). SCS can provide information on your state's rehabilitation laws and regulations, and where to go for further help.
- Local mining companies. They know first-hand the problems of rehabilitation, and they may be willing to share their experience.
- Conservation organizations, environmental groups, civic organizations, scouts, National Guard, Youth Conservation Corps, Job Corps. All may be possible sources of people and equipment for grading and planting work.

Other sources of information, technical help, and financial help in rehabilitation are at the State and Federal levels. Possible sources are shown below and in Table 1.



## HELP FROM FEDERAL GOVERNMENT SOURCES

(Source: Bureau of Outdoor Recreation;  
*Federal Directory*, 3rd Ed.)

### Information:

U. S. Department of Agriculture (USDA)  
Agricultural Research Service  
Washington, D. C. 20250

*Services:* Research on methods of rehabilitation, including current studies in the Northern Great Plains coal area.

### Information:

U. S. Department of Agriculture (USDA)  
Extension Service  
Washington, D. C. 20250

*Services:* Information on recreational use of surface-mined land. Provides educational programs through State land-grant colleges/universities and State and County Extension Services.

### Financial Aid:

U. S. Department of Agriculture (USDA)  
Farmers Home Administration  
Washington, D. C. 20250

*Services:* Farm loans for income-producing outdoor recreation. Funds can be used to develop land/water resources; buy land, equipment, livestock, and outdoor-recreation items; repair and construct buildings; and pay recreation operating expenses. (Get loan application forms from the Farmers Home Administration office in the county seat.)

### Information, Technical Aid:

U. S. Department of Agriculture (USDA)  
Forest Service  
Washington, D. C. 20250

### *Services:*

1. Direct assistance in rehabilitation, including design and installation of vegetative treatments for surface-mined land; help in advance planning to minimize mining's impact and produce useful land after mining; and provision of inexpensive seedlings for rehabilitation plantings. Services are available through Forest Service/State Forest Agency Cooperative programs.

2. Research on rehabilitation methods for damaged watersheds and surface-mined land. Also, research on adaptability of various plants to mine spoils; spoil treatments to promote plant growth; methods of spoil handling, placement, and drainage; and plant field tests.

### *Forest Service Regional Offices*

Director  
Forest and Range Experiment Station  
240 West Prospect Street  
Fort Collins, CO 80521

Director  
Forest and Range Experiment Station  
507 — 25th Street  
Ogden, UT 84401

Deputy Regional Forester  
State and Private Forestry  
517 Gold Avenue, S. W.  
Albuquerque, N. M. 87101

Deputy Regional Forester  
State and Private Forestry  
Denver Federal Center  
Denver, CO 80225

Deputy Regional Forester  
State and Private Forestry  
Federal Building  
Missoula, MT 59801

Deputy Regional Forester  
State and Private Forestry  
324 — 25th Street  
Ogden, UT 84401

### Information, Technical Aid:

U. S. Department of Agriculture (USDA)  
Forest Service  
SEAM Program  
145 Grand Avenue  
Billings, MT 59102

*Services:* Rehabilitation research, application, technical information, planning, and demonstration sites, in the heart of the Northern Great Plains coal area.

### Information, Technical Aid, Financial Aid:

U. S. Department of Agriculture (USDA)  
Soil Conservation Service  
Washington, D. C. 20250

**Services:**

1. Aid to State and local agencies in developing rehabilitation programs. Services include soil surveys; soil maps and interpretation; guidelines for planning and conservation; aid to operators and landowners in planning land use and treatment during and after mining; test plantings for erosion control and natural beauty; seeding techniques; on-site help in stockpiling topsoil and subsoil, disposing of toxic spoil, and designing reservoirs; helping the 3,000 local soil conservation districts review operators' rehabilitation plans.
2. Financial aid in construction of water-based recreation areas for public use. (Contact the local Soil Conservation District Office for information.)

**Information:**

Environmental Protection Agency (EPA)  
Washington, D. C. 20460

**Services:** Research on rehabilitation methods.

**Land Sale:**

General Services Administration  
Property Management & Disposal Service  
Washington, D. C. 20405

**Services:** Can assign surface-mined land to the Department of the Interior for "sale" (at up to 100% discount from fair market value) to any state or municipality for recreational use.

**Technical Aid, Financial Aid:**

U. S. Department of Housing and Urban  
Development (HUD)  
Community Planning and Management  
Washington, D. C. 20410

**Services:** Comprehensive planning assistance and 66%–75% financial-aid grants in the area of community development to (1) state agencies, (2) area-wide planning agencies, (3) counties, (4) cities, (5) local development districts, (6) economic development districts, (7) Indian nations, (8) major-disaster areas, and (9) locations with populations under 50,000. (Applicants in categories (2), (3), (7), and (9) apply through designated state agency; all others apply to their HUD area office.)

**Information:**

U. S. Department of the Interior  
U. S. Geological Survey (USGS)  
Washington, D. C. 20244

**Services:** Regulates surface mining and rehabilitation on Federal and Indian lands; inspects mining plans for adequate environmental safeguards and rehabilitation; conducts on-site inspections during mining; inspects rehabilitation work for adequacy.

**Technical Aid:**

U. S. Department of the Interior  
Bureau of Land Management (BLM)  
Washington, D. C. 20240

**Services:** Helps select the "best" uses for land, through careful description and analysis of natural resources and social-economic impacts.

**Information:**

U. S. Department of the Interior  
Bureau of Mines (USBM)  
Washington, D. C. 20240

**Services:** Research on rehabilitation; demonstration projects; cost-benefit evaluations of surface mining and rehabilitation.

**Technical Aid:**

U. S. Department of the Interior  
National Park Service (NPS)  
Washington, D. C. 20240

**Services:** Technical aid in park planning.

**Regional Offices**

For the Dakotas, Montana, Wyoming, Colorado, Nebraska, Kansas, Missouri, Minnesota, Iowa:

U. S. Department of the Interior  
National Park Service  
Midwest Regional Office  
1709 Jackson Street  
Omaha, Nebraska 68102

For Utah, Arizona, New Mexico, Texas, Oklahoma:

U. S. Department of the Interior  
National Park Service  
Southwest Regional Office  
Old Santa Fe Trail  
P. O. Box 728  
Santa Fe, New Mexico 87501

For Nevada, California, Hawaii:

U. S. Department of the Interior  
National Park Service  
Western Regional Office  
450 Golden Gate Avenue  
Box 36063  
San Francisco, California 94102

For Idaho, Oregon, Washington, Alaska:

U. S. Department of the Interior  
National Park Service  
Pacific Northwest Regional Office  
523 Fourth & Pike Building  
Seattle, Washington 98101

**Financial Aid:**

U. S. Department of the Interior  
Bureau of Outdoor Recreation  
Washington, D. C. 20240

*Services:* Financial help for recreational acquisition and development projects, and for state comprehensive outdoor recreation planning. Surface-mined land rehabilitation projects that qualify are eligible for grants. Has demonstration projects on former surface mines in Kellogg, Idaho (city/school park); Ontario, Oregon (water recreation); Jackson County, Oregon (regional park); King County, Washington (park); and Spokane County, Washington (park). (Submit project proposals to the Regional Office through the agency designated in your state.)

**Regional Offices**

For Alaska, Idaho, Oregon, Washington:

Regional Director  
Bureau of Outdoor Recreation  
915 Second Avenue  
Seattle, Washington 98174

For Arizona, Nevada, California:

Regional Director  
Bureau of Outdoor Recreation

Box 36062  
450 Golden Gate Avenue  
San Francisco, California 94102

For Colorado, Montana, Utah, Wyoming, the Dakotas, Nebraska, Kansas, Iowa, Missouri:

Regional Director  
Bureau of Outdoor Recreation  
P. O. Box 25387  
Building 41  
Denver Federal Center  
Denver, Colorado 80225

For New Mexico, Oklahoma, Texas, Arkansas, Louisiana:

Regional Director  
Bureau of Outdoor Recreation  
5000 Marble, N. E.  
Room 211  
Albuquerque, New Mexico 87110

**Information, Technical Aid:**

U. S. Department of the Interior  
Bureau of Reclamation  
Washington, D. C. 20240

*Services:* Rehabilitation planning, engineering, coordination of work with other agencies, and construction management, covering fish/wildlife habitat restoration, water treatment, revegetation, watershed management, recreation, etc.

**Financial Aid:**

U. S. Department of the Interior  
Bureau of Sport Fisheries and Wildlife  
Washington, D. C. 20240

*Services:* Qualified rehabilitation projects performed by States involving fish and wildlife restoration may be eligible for financial help up to 75% of the cost of work. (State Fish and Game Departments should submit project proposals to their regional Bureau office.)



TABLE 1

## HELP FROM STATE SOURCES

<i>State</i>	<i>Information on Laws, Regulations<sup>1</sup></i>	<i>Information on Available Technical and Financial Aid<sup>2</sup></i>	<i>Information on Available Tech. &amp; Financial Aid for Recreational Rehab.<sup>2</sup></i>	<i>Information on Aid Available and on State Regulations<sup>3</sup></i>	<i>Technical Aid in Plant Selection, Planting Methods, Soil Amendments<sup>4</sup></i>
Alaska	_____	Liaison Prog. Officer U.S. Bureau of Mines Room G-81, Fed. Bldg. Anchorage, AK 99501	Director Div. of Parks 323 E. Fourth Ave. Anchorage, AK 99501	Director Div. of Agriculture Alaska Dept. of Natural Resources P.O. Box 1088 Palmer, AK 99645	Institute of Agricultural Sciences University of Alaska College, AK 99701
Arizona	Board of Governors Dept. of Mineral Resources Mine Bldg. State Fair Grounds Phoenix, AZ 85007	Liaison Prog. Officer U.S. Bureau of Mines Room 1012 2721 N. Central Ave., Phoenix, AZ 85004	Director Outdoor Recreation Coordinating Comm. 4433 N. 19th Ave. Suite 203 Phoenix, AZ 85015	Commissioner State of Arizona Land Dept. 1624 W. Adams St. Phoenix, AZ 85007	College of Agriculture University of Arizona Tucson, AZ 85721
California	_____	Liaison Prog. Officer U.S. Bureau of Mines 450 Golden Gate Ave. P.O. Box 36012 San Francisco, CA 94102  Liaison Prog. Officer U.S. Bureau of Mines Room 3046 650 Capitol Mall Sacramento, CA 95814	Director Dept. of Parks & Recreation 1416 - 9th St. Room 1311 Sacramento, CA 95814	Staff Secretary California Assoc. of Resource Conservation Districts Room 214, Forum Bldg. 1107 - 9th St. Sacramento, CA 95814	Agricultural & Environ- mental Sciences University of CA/Davis Davis, CA 95616
Colorado	Comm. of Mines Colorado Bureau of Mines 210 Columbia Bldg. 1845 Sherman St. Denver, CO 80203	Liaison Prog. Officer U.S. Bureau of Mines Bldg. 20, Fed. Center Denver, CO 80225	Director Div. of Parks & Outdoor Recreation Dept. of Natural Resources 6060 Broadway St. Denver, CO 80216	Director Colorado State Soil Conservation Board 251 Columbine Bldg. 1845 Sherman St. Denver, CO 80203	College of Agricultural Sciences Colorado State Univ. Fort Collins, CO 80521
Idaho	Comm. of Public Lands State Capitol Bldg. Boise, ID 83701	Liaison Prog. Officer U.S. Bureau of Mines Room 447, Fed. Bldg. 550 W. Fort St. Boise, ID 83702	Director Idaho Dept. of Parks & Recreation Statehouse Boise, ID 83707	Administrative Officer Idaho State Soil Conser- vation Comm. Statehouse Boise, ID 83720	College of Forestry, Wildlife & Range Sciences University of Idaho Moscow, ID 83843

<i>State</i>	<i>Information on Laws, Regulations<sup>1</sup></i>	<i>Information on Available Technical and Financial Aid<sup>2</sup></i>	<i>Information on Available Tech. &amp; Financial Aid for Recreational Rehab.<sup>2</sup></i>	<i>Information on Aid Available and on State Regulations<sup>3</sup></i>	<i>Technical Aid in Plant Selection, Planting Methods, Soil Amendments<sup>4</sup></i>
Iowa	Iowa State Mine Inspector State of Iowa Mines & Minerals Dept. Capitol Bldg. Des Moines, IA 50319	Liaison Prog. Officer U.S. Bureau of Mines P.O. Box 1187 Rolla, MO 65401 [Contact for Iowa programs]	Director State Conservation Commission State Office Bldg. 300 Fourth St. Des Moines, IA 50319	Director State Soil Conserva- tion Committee Governing Body of the Iowa Dept. of Soil Conservation Grimes State Office Bldg. Des Moines, IA 50319	College of Agriculture Iowa State Univ. of Science & Technology Ames, Iowa 50010
Kansas	Director of Industrial Safety Division Kansas Dept. of Labor 401 Topeka Ave. Topeka, KS 66603	Liaison Prog. Officer U.S. Bureau of Mines Room 518 Capitol Fed. Bldg. 700 Kansas Ave. Topeka, KS 66603	Director State Park & Resources Authority 801 Harrison Topeka, KS 66612	Executive Secretary Kansas State Conserva- tion Commission Room 406, Mills Bldg. Topeka, KS 66612	College of Agriculture Kansas State Univ. of Agriculture & Applied Science Manhattan, KS 66502
Minnesota	Mineral Resources Environmental Coordinator Div. of Water Soils & Minerals Dept. of Natural Resources 345 Centennial Office Bldg. St. Paul, MN 55101	Liaison Prog. Officer U.S. Bureau of Mines Room G-23, Fed. Bldg. Fort Snelling Twin Cities, MN 55111	Director Dept. of Natural Resources 301 Centennial Bldg. 658 Cedar St. St. Paul, MN 55101	Executive Secreatry Minnesota State Soil & Water Conservation Commission Dept. of Natural Resources 300 Centennial Bldg. St. Paul, MN 55155	College of Agriculture, Forestry, & Home Economics University of Minnesota Minneapolis, MN 55455
Missouri	Director Land Reclamation Commission State Capitol Bldg. Room B-36 Jefferson City, MO 65101	Liaison Prog. Officer U.S. Bureau of Mines P.O. Box 1187 Rolla, MO 65401	Executive Secretary Inter-Agency Council for Outdoor Recreation 1203 Jefferson Bldg. Box 564 Jefferson City, MO 65101	Director Missouri State Soil & Water Districts Commission 1014 Madison P.O. Box 1368 Jefferson City, MO 65101	College of Agriculture University of Missouri/ Columbia Columbia, MO 65201
Montana	Commissioner Dept. of State Lands State Capitol Helena, MT 59601	Liaison Prog. Officer U.S. Bureau of Mines 636 North Logan Helena, MT 59601	Administrator Recreation & Parks Division Montana Dept. of Fish & Game Mitchell Bldg. Helena, MT 59601	Administrator Montana Dept. of Natural Resources & Conservation Conservation Districts Div. 32 South Ewing Helena, MT 59601	College of Agriculture Montana State Univ. Bozeman, MT 59715
Nebraska	_____	Liaison Prog. Officer U.S. Bureau of Mines Room 518 Capitol Fed. Bldg. 700 Kansas Ave. Topeka, KS 66603 [Contact for Nebraska program]	Director Game & Parks Commission 2200 N. 33rd St. P.O. Box 30370 Lincoln, NB 68503	Executive Secretary Nebraska Natural Resources Comm. 7th Floor Terminal Bldg. Lincoln, NB 68508	College of Agriculture University of Nebraska/ Lincoln Lincoln, NB 68508



Table 1. (continued)

<i>State</i>	<i>Information on Laws, Regulations<sup>1</sup></i>	<i>Information on Available Technical and Financial Aid<sup>2</sup></i>	<i>Information on Available Tech. &amp; Financial Aid for Recreational Rehab.<sup>2</sup></i>	<i>Information on Aid Available and on State Regulations<sup>3</sup></i>	<i>Technical Aid in Plant Selection, Planting Methods, Soil Amendments<sup>4</sup></i>
Nevada		Liaison Prog. Officer U.S. Bureau of Mines Room 306 U.S. Post Office Bldg. 705 N. Plaza St. Carson City, NV 89701	Director Dept. of Conservation & Natural Resources Nye Bldg. Room 214 Carson City, NV 89701	Administrator Nevada Conservation Commission & Div. of Sonsevation Districts 201 S. Fall St. Carson City, NV 89701	College of Agriculture University of Nevada/Reno Reno, NV 89507
New Mexico	Chairman State Coal Surface Mining Commission P.O. Box 2348 Santa Fe, NM 87501	Liaison Prog. Officer U.S. Bureau of Mines P.O. Box 1436 Socorro, NM 87801	State Planning Officer Executive Legislative Building Room 406 Santa Fe, NM 87501	Executive Secretary New Mexico Natural Resource Conserva- tion Commission 321 W. San Francisco Santa Fe, NM 87501	College of Agriculture New Mexico State University Las Cruces, NM 88001
North Dakota	Public Service Comm. State of North Dakota Capitol Bldg. Bismarck, ND 58501	Liaison Prog. Officer U.S. Bureau of Mines Suite 10 219 North 7th Bismarck, ND 58501	Coordinator State Outdoor Recreation Agency State Office Bldg. 900 East Blvd. Bismarck, ND 58501	Executive Secretary North Dakota State Soil Conservation Committee State Capitol Bismarck, ND 58501	College of Agriculture North Dakota State University of Agricul- ture & Applied Science Fargo, ND 58102
Oklahoma	Chief Mine Inspector Oklahoma Dept. of Mines Capitol Bldg. Oklahoma City, OK 73105	Liaison Prog. Officer U.S. Bureau of Mines 168 Post Office Bldg. N.W. Third St. Oklahoma City, OK 73102	Director Div. of State Parks Tourism & Recreation Dept. 500 Will Rogers Memorial Bldg. Oklahoma City, OK 73105	Executive Director Oklahoma Conserva- tion Comm. 20 State Capitol Bldg. Oklahoma City, OK 73105	College of Agriculture Oklahoma State Univ. Stillwater, OK 74074
Oregon	State Geologist Dept. of Geology & Mineral Industries 1069 State Office Bldg. Portland, OR 97201	Liaison Prog. Officer U.S. Bureau of Mines Suite 7 Standard Ins. Bldg. 475 Cottage St., N.E. Salem, OR 97301	Administrator of Highways State Highway Div. Room 300 State Highway Bldg. Salem, OR 97310	Director Oregon State Soil & Water Conservation Commission Room 20 Agriculture Bldg. Salem, OR 97310	School of Agriculture Oregon State Univ. Corvallis, OR 97331
South Dakota	Executive Secretary State Conservation Commission Office Bldg. No. 1 Pierre, SD 57501	Liaison Prog. Officer U.S. Bureau of Mines P.O. Box 867 Rapid City, SD 57701	Director South Dakota Dept. of Game, Fish & Parks State Office Bldg. Pierre, SD 57501	Executive Secretary South Dakota Conservation Comm. Dept. of Environmental Protection Bldg. No. 2 Pierre, SD 57501	College of Agriculture & Biological Sciences South Dakota State University Brookings, SD 57006



Table 1. (continued)

<i>State</i>	<i>Information on Laws, Regulations<sup>1</sup></i>	<i>Information on Available Technical and Financial Aid<sup>2</sup></i>	<i>Information on Available Tech. &amp; Financial Aid for Recreational Rehab.<sup>2</sup></i>	<i>Information on Aid Available and on State Regulations<sup>3</sup></i>	<i>Technical Aid in Plant Selection, Planting Methods, Soil Amendments<sup>4</sup></i>
Texas	Director Field Operations/ Surface Mining Ernest O. Thompson Building Austin, TX 78711	Liaison Prog. Officer U.S. Bureau of Mines Room 980 Federal Bldg. Austin, TX 78701	Executive Director Parks & Wildlife Dept. John H. Reagan Bldg. Austin, TX 78701	Executive Director Texas State Soil & Water Conservation Board 1018 First National Building Temple, TX 76501	College of Agriculture Texas A&M Univ. College Station, TX 77843
Utah	Director Division of Oil, Gas, & Mining 1588 W. North Temple Salt Lake City, UT 84116	Liaison Prog. Officer U.S. Bureau of Mines 1600 E. First South St. Salt Lake City, UT 84112	Executive Director Dept. of Natural Resources 319 State Capitol Building Salt Lake City, UT 84114	Executive Secretary Utah States Soil Conservation Commission Room 412 Utah State Capitol Building Salt Lake City, UT 84114	College of Agriculture Utah State University Logan, UT 84321
Washington	Assistant Supervisor Div. of Mines & Geology Dept. of Natural Resources Olympia, WA 98504	Liaison Prog. Officer U.S. Bureau of Mines 909 Capitol Center Building Olympia, WA 98501	Chairman Interagency Committee for Outdoor Recreation 4800 Capitol Blvd. Tumwater, WA 98504	Executive Secretary Washington State Conservation Commission Olympia, WA 98504	College of Agriculture Washington State University Pullman, WA 99163
Wyoming	Director Environmental Quality Dept. of Land Div. State Office Bldg. Cheyenne, WY 82002	Liaison Prog. Officer U.S. Bureau of Mines P.O. Box 1796 Cheyenne, WY 82001	Director Wyoming Recreation Commission Box 309 State Office Bldg. Cheyenne, WY 82001	Executive Secretary Wyoming State Conservation Commission 2219 Carey Ave. Cheyenne, WY 82002	College of Agriculture University of Wyoming Laramie, WY 82070

Sources: <sup>1</sup> American Mining Congress<sup>2</sup> Bureau of Outdoor Recreation<sup>3</sup> National Association of Conservation Districts<sup>4</sup> Comparative Guide to American Colleges, 5th Ed.

## USEFUL SOURCES

1. Study Committee on the Potential for Rehabilitating Lands Surface Mined for Coal in the Western United States, Environmental Studies Board, National Academy of Sciences. *Rehabilitation Potential of Western Coal Lands. A Report to the Energy Policy Project of the Ford Foundation.* Cambridge, Mass.: Ballinger Publishing Co., 1974. 198 pp. Referenced figures are reprinted with permission.

Thoughtful, landmark study and overview of Western surface-mine rehabilitation problems; many statistics, charts, graphs; generous bibliography; good research source.

2. *Sources of Assistance in Reclaiming Surface-Mined Lands for Outdoor Recreation.* Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 1972. 72 pp. \$0.70.\*

For those planning rehabilitation for recreational use, this is a valuable source book.

3. *Papers Presented Before the First Research and Applied Technology Symposium on Mine-Land Reclamation (1973).* Bituminous Coal Research, Inc., 350 Hochberg Road, Monroeville, PA, March 1973. 355 pp. \$8.00.\*
4. *Papers Presented Before the Second Research and Applied Technology Symposium on Mined-Land Reclamation (1974).* National Coal Association, The Coal Building, 1130 Seventeenth Street, N. W., Washington, D. C., October 1974. 252 pp. \$8.00.\*
5. *Papers Presented Before the Third Symposium on Surface-Mining and Reclamation (1975).* National Coal Association, The Coal Building, 1130 Seventeenth Street, N. W., Washington, D. C., October 1975. Two volumes, 482 pp. \$14.00.\*

\* 1975 price, subject to change.

5. Paone, J., Morning, J. L., & Giorgetti, L. *Land Utilization and Reclamation in the Mining Industry, 1930-71.* Information Circular 8642. U. S. Dept. of the Interior - Bureau of Mines, U. S. Government Printing Office, Washington, D. C., 1974. 61 pp. \$1.05.\*

Statistics and diagrams by state.

7. Grim, E. C., & Hill, R. D. *Environmental Protection In Surface Mining of Coal.* National Environmental Research Center, Office of Research & Development, U. S. Environmental Protection Agency, Cincinnati, Ohio, October 1974. 277 pp.

Highly illustrated, thorough technical source on surface-mining and rehabilitation, mostly eastern but some western.

8. Packer, P. E. *Rehabilitation Potentials and Limitations of Surface-Mined Land in the Northern Great Plains.* USDA Forest Service General Technical Report INT-14, Intermountain Forest and Range Experiment Station, Ogden, Utah. U. S. Government Printing Office, Washington, D. C., July 1974. 44 pp.

Technical state-of-the-art report, including excellent map and discussion of classification systems for soil-vegetation-precipitation geographic units.

9. May, M., Lang, R., Lujan, L., Jacoby, P., & Thompson, W. *Reclamation of Strip Mine Spoil Banks in Wyoming.* Agricultural Experiment Station, University of Wyoming, Laramie. Research Journal 51, September 1971. 32 pp.
10. Cook, C. W., Hyde, R. M., & Sims, P. L. *Revegetation Guidelines for Surface-Mined Areas. (Guidelines for Revegetation and Stabilization of Surface-Mined Areas in the Western States).* Colorado State University, Range Science Dept., Sciences Series No. 16, December 1974. 73 pp.

Guidelines by region for plant selection, soil preparation, planting methods.



11. Spaulding, W. M., Jr., & Ogden, R. D. *Effects of Surface Mining on the Fish and Wildlife Resources of the United States*. Bureau of Sport Fisheries and Wildlife Resource Publication 68. U. S. Dept. of the Interior, Fish and Wildlife Service. Supt. of Documents, U. S. Government Printing Office, Washington, D. C., August 1968. 51 pp. \$0.60.\*

Thorough discussion of surface mining's impact on wildlife.

12. Rowe, J. E. *An Inventory of Unique Uses for Reclaimed Strip Mined Land in the Appalachian Region*. The University of Tennessee, Knoxville 36 pp.

Although written for Appalachia, a good "idea book" for possible uses of surface-mined land in the West.

\* 1975 price, subject to change.

